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resultant of a lineo-linear system of equations in its most perfect form. It is easy to obtain two different solutions, each of them unsymmetrical in respect of the data of the question; the conversion and fusion of each of these into one and the same determinant, symmetrical in all its relations to the data, is effected instantaneously by a process derived from the above theorem. In that particular application of it, the umbræ involved each represent columns of actual quantities in number equal to the number of places in the width and length of the umbral matrix to which they belong, so that each coefficient in the product of a lateral by a longitudinal factorial represents an ordinary determinant made up of these columns, from which it is evident that the polar law of sign and nullity necessary for the truth of the theorem are satisfied in the case supposed.

V. "Notes, principally on Thermo-electric Currents of the Ritterian Species." By C. K. Akin, Esq. Communicated by Professor Stokes, Sec. R.S. Received March 26, 1863.

(Abstract.)

The electromotive force of a thermo-electric couple is a function of the nature of the metals of which it is composed, and of the temperatures of the junctions. It is expressed in this paper by

$$[x, y]^{\mathrm{T}}_{t},$$

where x and y are names of metals, and T and t are temperatures. In this notation Becquerel's two laws become

$$[a, b]^{t''}_{t'} = [a, b]^{t''}_{t} - [a, b]^{t'}_{t}; \quad \ldots \quad \text{(I.)}$$

and

$$(a, c)^{\mathrm{T}}_{t} = [a, b]^{\mathrm{T}}_{t} + [b, c]^{\mathrm{T}}_{t}. \quad \ldots \quad \text{(II.)}$$

From (I.) we learn that the electromotive force of a couple may be expressed as the difference of two quantities which are functions of the temperature and of the nature of the circuit, or

$$[x, y]^{\mathrm{T}}_{t} = [x, y]_{\mathrm{T}} - [x, y]_{t}. \quad \ldots \quad \text{(III.)}$$

From (II.) we learn that any number of metals with their ends at the same temperature may be introduced without effect, or

$$[a, b]_t + [b, c]_t = [a, c]_t. \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(IV.)}$$

This equation will always be true if

$$[x, y]_t = [x]_t - [y]_t, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(V.)}$$

whence we may write (III.)

$$[x, y]_t^{\mathrm{T}} = [x]_t - [y]_t - [x]_{\mathrm{T}} + [y]_{\mathrm{T}};$$

or, in other words, the electromotive force of a couple may be considered as the difference of the electromotive force of two metals, each of which is found by subtracting its tension at the higher temperature from that of the lower one.

Everything therefore depends on a knowledge of the value of what may be called the electric tension of each metal at the various temperatures. This for every metal is a function of temperature, and may be called, in the language of the paper, a function of the nature (or name) of the metal and the temperature.

(The nature of the metal may be altered otherwise than chemically.)

If the temperature of the metal vary in any way throughout its length, then if it be homogeneous, the electromotive force will depend only on the temperatures of its extremities.

In a circuit of one metal, the author considers that at the junction of the ends there may be a real discontinuity of temperature while there is a continuity of electric current. He regards the explanation of the effect by the stratum of air between the unequally heated ends to be unsatisfactory. Mercury, as is known, will not produce thermo-currents in this way. The author considers that the texture, &c., as well as the chemical nature of the substance, influences the value of the thermo-electric function. He also shows the possibility of the thermo-electric inversions first discovered by Professor Cumming.